St John The Baptist Primary School

Calculation (including Bar Models) and expectations in maths

September 2022

St John The Baptist Primary School

Consistency, Progression and Understanding

- Number work and times tables are to underpin all maths teaching, as without these, children can not access other areas of the maths curriculum.
- Children need to be able to explain what they are doing and why they are doing it using accurate mathematical vocabulary.
- Consistency is essential to ensure children are encountering the same teaching of the methods, regardless of which teacher they are with.
- The calculation methods set out on the following pages are progressive and ensure children understand what they are doing and why they are doing it, before they move onto the next method.
- The aim is not to get children to the shortest method possible, especially if they do not understand the basics of the operation. It is to help them understand and to explain maths.

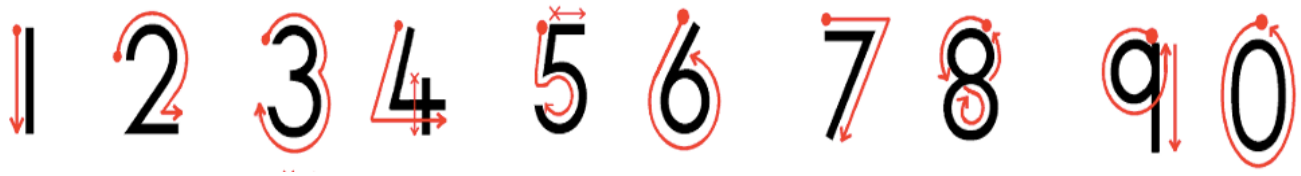
Marking in Maths

- Marking is to follow St John the Baptist's Marking and Feedback policy.
- Corrections are to be done in purple pen.
- Correction work includes incorrect answers, presentation and inaccurate number formation.
- If all work is correct, a challenge may be given. This is to be indicated by the heading 'Challenge Question'. It is a challenge and children may not be able to complete it... however they might surprise you!

Presentation and number formation

- Children are to place one digit in each square (using the word 'digit' and not 'number').
- Every Maths lesson starts with the next, blank page. Children are to write the short date and the daily arithmetic and reasoning title, which is 'DQ' (Daily Questions).
- Upon completing the daily questions, children are to start a new, blank page and write the title/learning focus for the context of the lesson.
- Children are to be taught to keep digits and symbols in one square and in columns (as appropriate).
- When drawing shapes, angles or graphs, lines must meet accurately

All children should use the following number formation:



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Bar Models

Introduction

- Bar Models are used as part of the Concrete, Pictorial, Abstract approach to mastery of Maths.
- Bar Models are pictorial representations of problems or concepts that can be used for any of the 4 operations, fractions, percentages, ratio and algebra. It is not a method for problem solving but it does reveal the mathematical structure beneath the problem and the relationship between its component parts. Bar models can help children decide with operations to use or to visualise problems.
- Although the use of the bar model is not statutory, it is expected that all staff will teach and model this approach as a method that the children can draw upon where and when required.
- The language of 'part' and 'whole' must be used consistently to allow for success with bar models (see vocabulary pages)

Progression in Bar Models

EYFS

Children starting in our 2-year-old provision will be introduced to Numicon.

- Concrete exploration
- Present items in a linear fashion
- Look at and discuss bar models with pictures e.g., ten frames
- Not expected to draw accurate models independently though could start drawing boxes around objects like a bar model
- Children should not be discouraged if they try to draw bar model jottings.

Year 1

Once children become confident with Numicon, they will be introduced to discrete bars using Cuisenaire rods.

- Draw discrete bar models accurately
- Look at and discuss continuous models
- Begin to use continuous models where it becomes inefficient to draw discrete models

Year 2

When appropriate for the individual child, they will then move onto the continuous model. Children will know rectangular bars (or boxes) are used to represent the known and unknown quantities in a problem.

Make a transition from discrete to continuous for most areas of Maths and be able to draw these independently and accurately with increasing levels of proportionality.

KS2

Use continuous models with increasing confidence. Ensuring proportionality is established.

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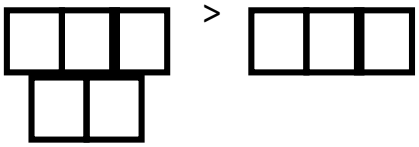
Bar Models

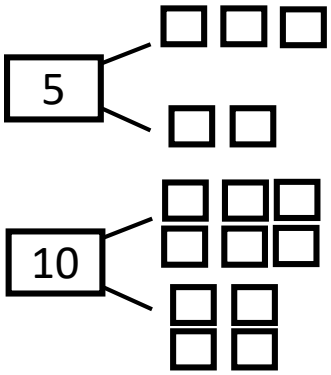
Place Value – Part, Whole Models

Comparing numbers – Discrete

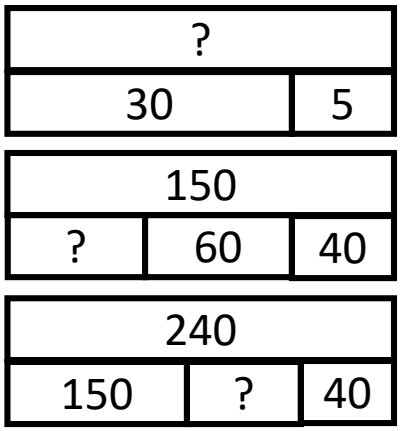


Continuous

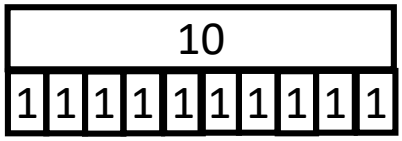
Part – Whole



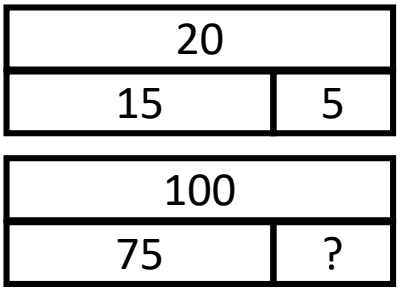
Continuous models –



Number Bonds – Discrete



Number Bonds – Continuous



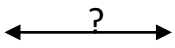
Can be used for fluency to 20/100 and calculating unknown quantities.

Comparison Bar Models

Bob has 5 apples and Jim has 2 apples. How many more does Bob have?

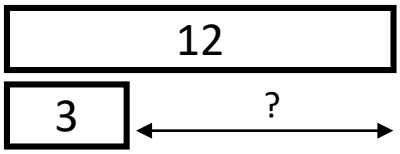
Bob =

Jim =



5 – 2 = 3

Sam has 12 football cards and Alex has 3. How many more cards does Sam have than Alex?



12 - 3 = 9

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Bar Models

Fraction Problems – Part, Whole Model

What is one quarter of 16?

16 ÷ 4 = 4

16			
4	?	?	?

One quarter of a number is 5, what is the number?

5 x 4 = 20

20			
5	?	?	?

Multi-step Problems – Part, Whole Model

3 pineapples cost the same as 2 mangoes.
1 mango costs £1.35.
How much does one pineapple cost?

1 mango costs £1.35 – we need 2.
The total of 2 mangoes is £2.70.
So, 3 pineapples = 2 mangoes
£2.70 ÷ 3 = £0.90

£2.70		
£1.35	£1.35	
90p	?	?

Algebra Problems – Part, Whole Model

3a + 5 = 17

What is the value of a?

Step 1 –

17	
12	5

17 – 5 = 12

Step 2 –

17			
12			5
4	?	?	5

12 ÷ 3 = 4

So, a = 4

Ratio Problems – Comparison Model

At the school disco, there are 5 girls, to every 3 boys.
If there are 136 children at the disco, how many more girls than boys are there?

Girls =

17	17	17	17	17

Boys =

17	17	17	?

Step 1 – 136 ÷ 8 = 17

Step 2 – Calculate the totals
Girls - 17 x 5 = 85 Boys - 17 x 3 = 51

Step 3 –
Calculate the difference
85 – 51 = 34
So, there are 34 more girls than boys at the disco.

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Addition

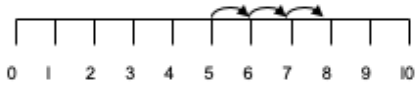
Foundation Stage and beginning of Year 1

Counting objects altogether

4 + 3 = 7

Count on using a number line, starting at the larger number.

8 + 3 = 11

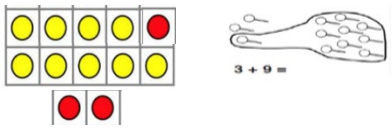


Place the larger number in your head and count on using your fingers.

Start with the bigger number and use the smaller number to make 10, using ten frames.

Using ten frames or a number line. Regroup or partition the smaller number using the part, whole model to make 10.

e.g., 9 + 3 = 12

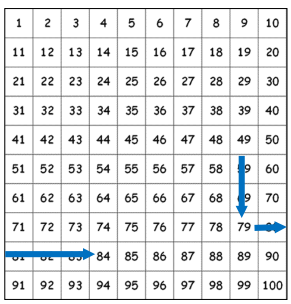


Using knowledge of ten frames to answer questions such as:

7 + 3 = 10

If I am at seven, how many more do I need to make 10? How many more do I add on now?

Years 1 and 2



49 + 35 = 84

Jump down 3 tens, count on 5 units.

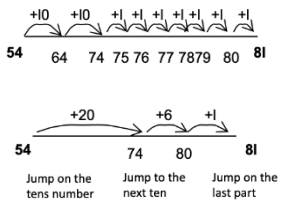
Partition the second number and use the place value 'hats'.

58 + 23 =
58 + 20 =
78
78 + 3 =
81

376 + 125 =
376 + 100 =
476
476 + 20 =
496
496 + 5 = 501

Count on using larger jumps.

54 + 27 = 81

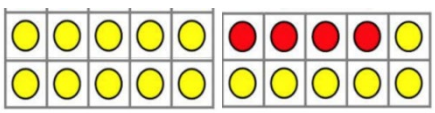


Addition with concrete objects

6 + 8 = 14

Addition with pictorial images

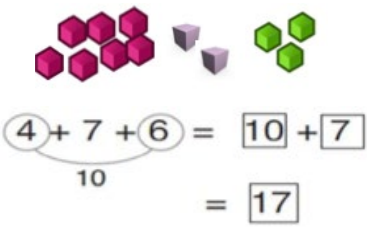
16 + 4 = 20



Add three 1-digit numbers

6 + 2 + 3 =

Combine to make 10s

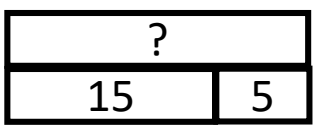


Use known facts

3 + 4 = 7
Leads to
30 + 40 = 70
Leads to
300 + 400 = 700

Use dienes, place value counters and Numicon

Discrete and Continuous Bar Models



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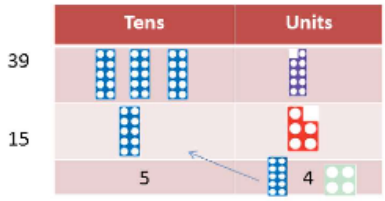
Addition

Years 3, 4, 5 and 6

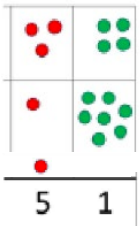
Use dienes, place value counters and Numicon



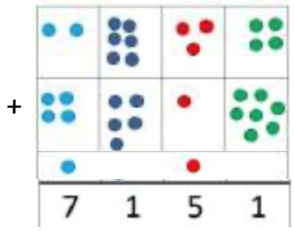
Exchange ten ones for a ten. Model using numicon and place value counters.

Children move to drawing the counters using place value grid

34 + 17=



2634 + 4517=



Continuous bar models

?	
43	78

?	
5000	8547

?		
307	234	269

8547	
5000	?

3894	
?	894

Column addition –
Always starting in the column on the right

	TH	H	T	O
	3	5	7	8
+		6	7	5
	1	1	1	
	4	2	5	3

	TH	H	T	O
	6	5	8	4
+	5	8	4	8
	1	1	1	
1	2	4	3	2

Column addition with decimals –
Inserting place holders as necessary

	T	O	·	t	h
	3	5	.	6	8
+	4	4	·	6	0
	1	1			
	8	0	·	2	8

	T	O	·	t	h
	3	5	.	6	8
+		4	·	2	3
				1	
	3	9	·	9	1

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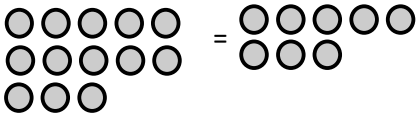
Subtraction

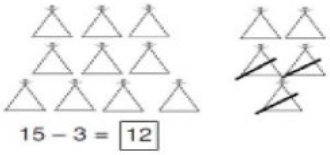
Foundation Stage and beginning of Year 1

Start with 13 objects and move 5 away.

13 – 5 = 8

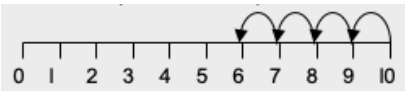


Cross out drawn objects to show what has been taken away

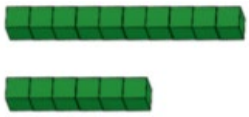


Count back using a number line.

10 - 4 = 6



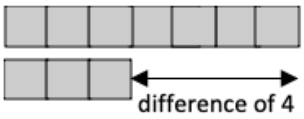
Use concrete apparatus in linear fashion to compare the sizes.



What is the difference between 10 and 6?

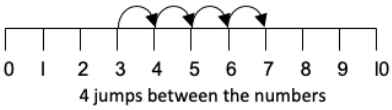
Use pictorial images to find the difference

7 - 4 = 3



Counting on using a number line

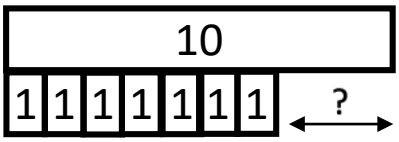
7 - 4 = 3

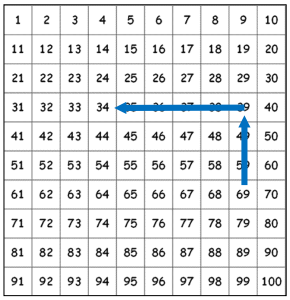


Years 1 and 2

Comparison discrete models to find the difference

10 – 3 =





69 - 35 = 34

Jump up 3 tens, count back 5 units.

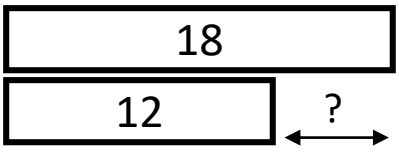
Partition the second number and use the place value 'hats'.

58 - 23 =
58 - 20 =
38
38 - 3 =
35

376 - 125 =
376 - 100 =
276
276 - 20 =
256
256 - 5 = 251

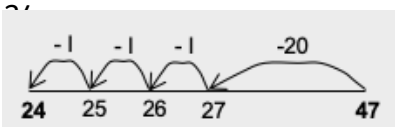
Comparison continuous models to find the difference

18 – 12 =

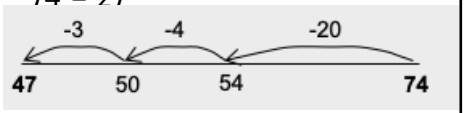


Count back

47 – 23 =

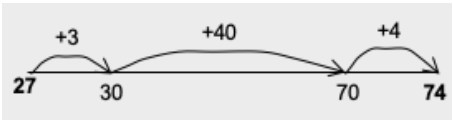


74 – 27

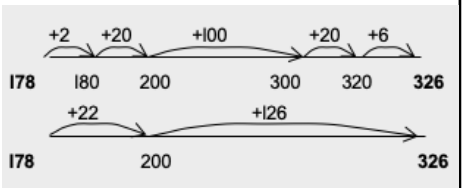


Counting on

74 – 27 = 47



326 – 178 = 148



Use a pictorial representation

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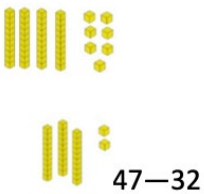
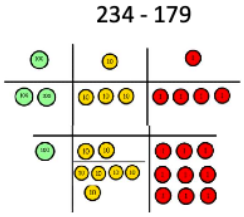
Subtraction

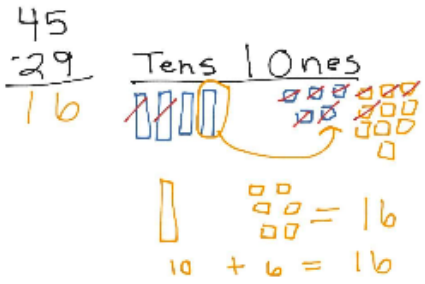
Year 3, 4, 5 and 6

Use concrete objects





Children to draw a pictorial representation



Continuous Bar Model

15 – 5 = ?

15	
?	5

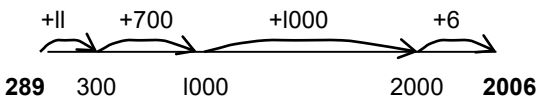
250 - ? = 30

250	
130	?

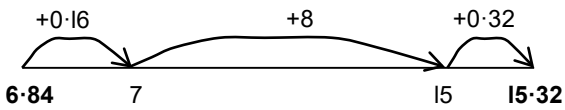
Always ask – 'Where does the question mark go?'

Counting on

2006 – 289 =



15.32 – 6.84 =



Column Subtraction

	H	T	O
	5	$^{5}\cancel{6}^{1}$	3
-	2	4	8
	3	1	5

	T	O	·	t	h
	1	5	·	$^{5}\cancel{6}^{1}$	3
-		2	·	4	8
	1	3	·	1	5

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Multiplication

Foundation Stage and beginning of Year 1

Repeated Addition, using concrete or pictorial methods

2 + 2 + 2 + 2 + 2 = 10

This is the same as:

2 x 5 = 10

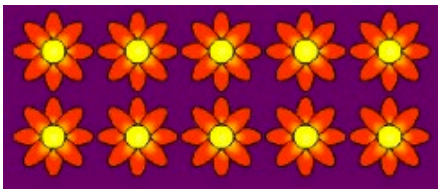
2 multiplied by 5

5 pairs

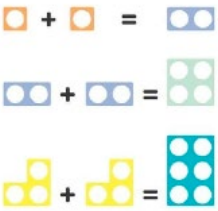
Counting in equal steps, using concrete or pictorial methods

Children should know how to count in 2s, 5s and 10s

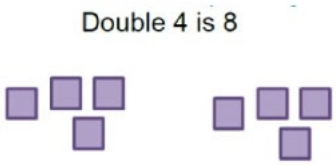
Use objects laid out in arrays to find the answers to 2 lots of 5, etc.



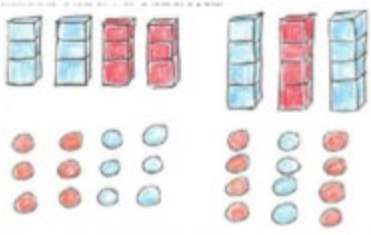
Use practical activities using manipulatives including cubes and Numicon to demonstrate doubling



Draw pictures to show how to double numbers

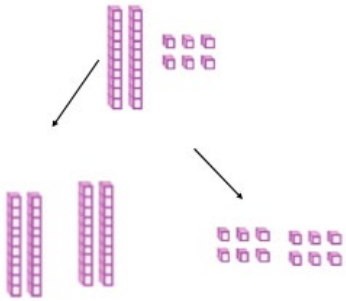


Draw representations of arrays to show understanding

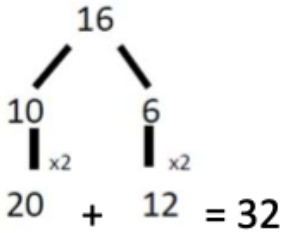


Years 1 and 2

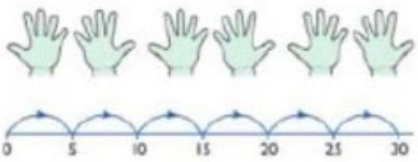
Model doubling using Dienes and counters



Partition a number and then double each part before recombining it back together

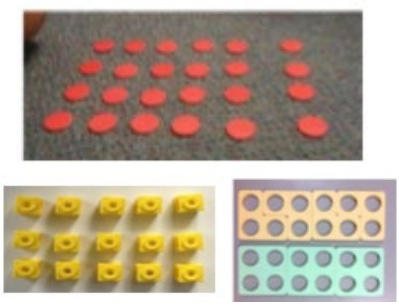


Count the groups, using concrete, pictorial and abstract methods

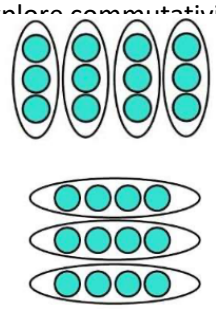


5 + 5 + 5 + 5 + 5 + 5 + 5 + 5 =. 40

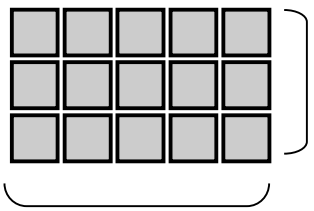
Create arrays using counters, cubes



Use pictorial images to represent arrays. Using this opportunity to explore commutativity



Use understanding of arrays to calculate 3 x 5 mentally



5 x 3 = l5

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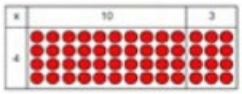
Multiplication

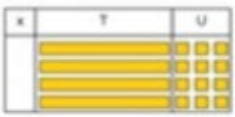
Years 3, 4, 5 and 6

Show the links with arrays to first introduce the grid method



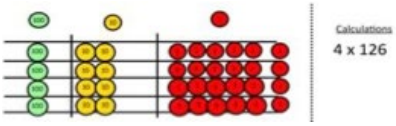
4 rows of 10
4 rows of 3

Move onto base ten to move towards a more compact method



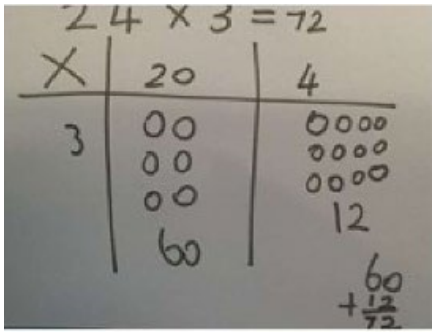
4 rows of 13

Move onto place value counters to show how we are finding groups of a number. We are multiplying by 4 so we need 4



Children can represent their work with place value counters in a way that they understand.

They can draw the counters using colours to show different amounts or just use circles in the different columns to show their thinking as shown below



Start with multiplying by one digit numbers and showing the clear addition alongside the grid.

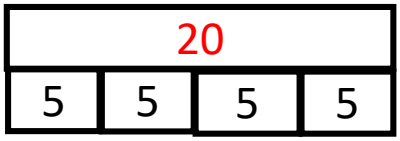
×	30	5
7	210	35

210 + 35 = 245

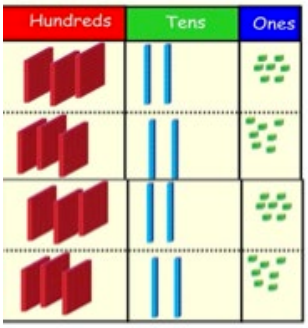
Continuous Bar Model

e.g., Ali has four friends and wants to give each of them 5 sweets.

How many sweets will Ali need to have?



Concrete and pictorial column multiplication



It is important at this stage that they always multiply the ones first.

Short Multiplication

38 x 7=

	T	O
	3	8
x		7
	5	
2	6	6

8 x 7 = 56
3 x 7 = 21
Adding the carried 5 tens = 26

Long Multiplication

584 x 48

	H	T	O
	5	8	4
x		4	8
	~~6~~	~~3~~	
4	6	7	2

		H	T	O
		5	8	4
	x		4	~~8~~
		~~3~~	~~1~~ ~~3~~	~~3~~
	4	6	7	2
+	2	3	3	6 0
			1	
	2	8	0	3 2

584 x 8 = 4672
Add placeholder
584 x 4 = 2336
4672 + 23360 = 28032

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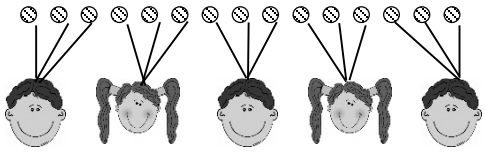
Division

Foundation Stage and beginning of Year 1

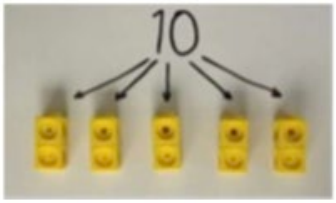
Sharing – using concrete and pictorial

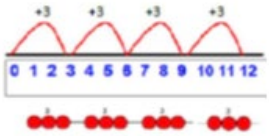
15 marbles are shared equally among 5 children.

15 ÷ 3 = 5



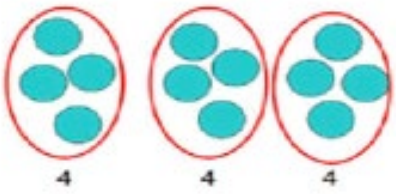
Grouping – using concrete and pictorial





12 ÷ 3 = 4

Sharing:



12 shared between 3 is 4

Cut a pizza in half.

How many pieces are there?

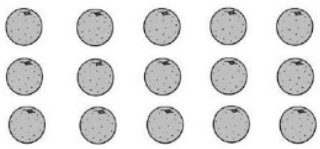
Years 1 and 2

Grouping – using concrete, pictorial and abstract

24 divided into groups of 6 = 4

96 ÷ 3 = 32

Division with arrays – using concrete and pictorial



Box and Spot

Using the inverse

20 ÷ 5

"How many 5s in 20?"

4 x 5 = 20 so 20 ÷ 5 = 4

Inverse examples:

1 x 4 = 4 so 4 ÷ 4 = 1

2 x 4 = 8 so 8 ÷ 4 = 2

3 x 4 = 12 so 12 ÷ 4 = 3

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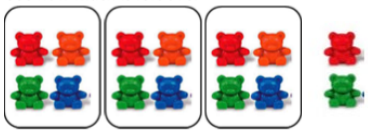
Division

Years 3, 4, 5 and 6

Division with remainders

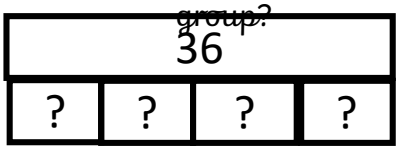
Divide objects between groups and see how much is left over



Draw dots and group them to divide an amount and clearly show a remainder.

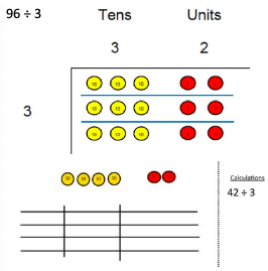
Continuous Bar Model

e.g., On sports day, 36 children split into four groups. How many children are in each group?



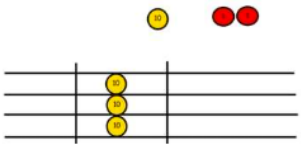
36 ÷ 4 =

Short Division – Concrete, Pictorial and Abstract

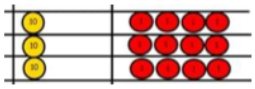


42 ÷ 3=

Start with the biggest place value, we are sharing 40 into three groups. We can put 1 ten in each group and we have 1 ten left over

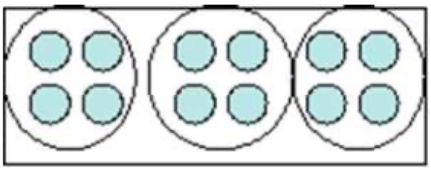


We exchange this ten for ten ones and then share the ones equally among the groups.



We look how much in 1 group so the answer is 14.

Students can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups.



56 ÷ 2 =

$$\begin{array}{r} 28 \\ 2\overline{)56} \end{array}$$

196 ÷ 6 =

$$\begin{array}{r} 032\ r4 \\ 6\overline{)196} \end{array}$$

Years 5 and 6

Long Division

378 ÷ 27 = 14

$$\begin{array}{r} 014 \\ 27\overline{)378} \\ 270 \quad (\times 10) \\ \hline 108 \quad (\times 4) \end{array}$$

27
54
81
108

Find how many 27s go into 378.
10 x 27 = 270
378 – 270 = 108

Find how many 27s go in to 108
4 x 27 = 108
Answer 14

4464 ÷ 16 = 279

$$\begin{array}{r} 0279 \\ 16\overline{)4464} \\ 3200 \quad (\times 200) \\ \hline 1264 \\ 1120 \quad (\times 70) \\ \hline 144 \quad (\times 9) \end{array}$$

16
32
48
64
80
96
112
128
144

Find how many 16s go in to 4646
200x16=3200
4464-3200=1264

Find how many 16s go in to 1264
70x16=1120
1264-1120=144

Find how many 16s in 144
9x16=144
Answer=279

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Vocabulary

All teachers are to refer to the Rising Star vocabulary, which is located on the following pages, and use the appropriate vocabulary from the year group level the children are working at. Consistency in the vocabulary we use is paramount to avoid confusion and ensure success throughout school.

The following pages set out Key Stage 1 (KS1) and Key Stage 2 (KS2) maths vocabulary under the National Curriculum. The tables can be used to check pupils' understanding of new vocabulary introduced in Year 1-6.

The lists are intended as a guide as to what pupils should know and are not exhaustive. Of course, key terms may be introduced earlier as a challenge for our learners, although it is also important to ensure that learning is 'new' and carries an element of surprise.

It is expected that key vocabulary is displayed as appropriate and discussed at times during the academic year. It is expected that this vocabulary is promoted through mathematical talk in lessons.

Key Questions within Bar Modelling

- What do we know?
- What is the unknown?
- What do we want to know?

- If I know this, therefore I know...
- Label the 'known' parts and/or wholes
- Label the 'unknown' parts and/or wholes
- Write the number sentence/equation

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Vocabulary

New Vocabulary for Year 1

Number and Place Value

- Number, digit, figure(s)
- Zero, one, two, three to twenty,
- Count (on/up/to /from/down)
- Before, After
- More, less, many, few, fewer, least, fewest, smallest, greater, lesser
- Equal to, the same as
- Odd, even, pair
- Units, ones, tens
- Ten more/less
- Numeral
- Compare
- (in) order/a different order
- Between, halfway between
- Above, below

Addition and Subtraction

- Number bonds/line
- Add, more, plus, make, sum, total, altogether
- Double, half, halve
- Equals, is the same as (including =)
- Difference between
- How many more is… than…?
- How much more is…?
- Subtract, take away, minus
- How many fewer is… than…? How much less is…?

Multiplication and Division

- Odd, even
- Count in twos, threes, fives
- Count in tens (forwards /backwards from)
- How many times?
- Lots of, groups of
- Once, twice, three times, five times
- Multiple of, times, multiply, multiply by
- Repeated addition
- Array, row, column
- Double, halve
- Share, share equally
- Group in pairs, threes, etc.
- Equal groups of
- Divide, divided by, left, left over

Properties of Shape

- Group, sort
- Cube, cuboid, pyramid, sphere, cone, cylinder, circle, triangle, square
- Shape
- Flat, curved, straight, round
- Hollow, solid
- Corner (point, pointed)
- Face, side, edge
- Make, build, draw

Position and Direction

- Position
- Over, under, underneath, above, below, top, bottom, side
- On, in, outside, inside
- Around, in front, behind
- Front, back
- Before, after
- Besides, next to, opposite
- Apart
- Between, middle, edge, center
- Corner
- Direction
- Journey
- Left, right, up, down, forwards, backwards, sideways
- Across
- Close, far, near
- Along, through
- To, from, towards, away from
- Movement
- Slide, roll, turn, whole turn, half turn
- Stretch, bend

Fractions

- Whole
- Equal parts, four equal parts
- One half, two halves
- A quarter, two quarters

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Vocabulary

New Vocabulary for Year 1

General

- Fill in, shade, colour, tick, cross, draw, join (up) ring
- Count, work out, answer, check
- Number facts/line/track/square/cards
- Abacus, counters, cubes, blocks, rods, die, dice, dominoes, pegs, peg board
- Same way, different way, best way, another way
- In (a different) order
- Not all, every, each
- Listen, join in
- Say, think, imagine, remember
- Start from, start with, start at
- Look at, point to
- Put, place, fit
- Arrange, rearrange
- Change, change over
- Split, separate
- Carry on, continue, repeat, what comes next?
- Find, choose collect, use, make, build
- Tell me, describe, pick our, talk about, explain, show me
- Read, write, record, trace, copy, complete, finish, end

Measure

- Quick, quicker, quickest, quickly, fast, faster, fastest, slow, slower, slowest, slowly, old, older, oldest, new, newer, newest
- Takes longer, takes less time
- Hour, o'clock, half past, clock, watch, hands
- How long ago? How long will it be to…?
- How long will it take to…? How often?
- Always, never, often, sometimes, usually
- Estimate, close to, about the same as, just over, just under
- Too many, too few, not enough, enough
- Length, width, height, depth
- Full, half full, empty
- Holds, container
- Weight, weights, balances, scales
- Heavy, heavier, heaviest, light, lighter, lightest

Measure

- Long, longer, longest, short, shorter, shortest, tall, taller, tallest, high, higher, highest
- Low, wide, narrow, deep, shallow, thick, thin
- Far, near, close
- Meter, ruler, meter stick
- Money, coin, penny, price, cost, buy, sell, spend, spent, pay, change, dear, dearer, costs more, costs less, cheaper, costs the same as
- How much?
- How many?
- Total

Time

- Days of the week: Monday, etc.
- Seasons: spring, summer, autumn, winter
- Day, week, month, year, weekend
- Birthday, holiday
- Morning, afternoon, evening, night, midnight
- Today, yesterday, tomorrow
- Before, after, next, last
- Now, soon, early, late
- Once, twice
- First, second, third, etc.

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Vocabulary

New Vocabulary for Year 2

General	Number and Place Value	Measure	Fractions
Predict Describe the pattern/rule Find, find difference investigate	Numbers to one hundred Hundreds Partition, recombine Hundred more/less	Quarter past/to m/km, g/kg, ml/l Temperature Degrees	Three quarters, one third, a third Equivalence Equivalent

Properties of Shape	Position and Direction	Data/Statistics
Rotation Clockwise, anticlockwise Straight line Ninety-degree turn Right angle	Size, bigger, larger, smaller Symmetrical Line of symmetry Fold Match Mirror line, reflection Repeating pattern	Count, tally, sort, vote Graph, block graph, pictogram Represent Group, set, list, table Label, title Most/least popular Most/least common

New Vocabulary for Year 3

Number and Place Value	Addition and Subtraction	Data/Statistics	Fractions, Decimals and Percentages
Numbers to one thousand	Column addition and subtraction	Chart Bar chart Frequency table Carroll diagram Venn diagram Axis, axes Diagram	Numerator Denominator Unit & non-unit fractions Compare order Tenths
Multiplication and Division	**Position and Direction**	**Properties of Shape**	**Measure**
Product Multiples of four, eight, fifty and one hundred Scale up	Greater/less than ninety degrees Orientation (same/different)	Horizontal Vertical Perpendicular and parallel lines	Leap year Twelve-hour Twenty-four-hour clock Roman numerals I to XIII

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Vocabulary

New Vocabulary for Year 4

Number and Place Value	Multiplication and Division	Position and Direction	Properties of Shape
Tenths, hundredths Decimal Round (to nearest) Negative integers Count through zero Roman numerals	Multiplication facts Division facts Inverse Derive	Co-ordinates Translation Quadrant X-axis, Y-axis Perimeter Area	Quadrilaterals Triangles Right angle Acute angle Obtuse angle

Measure	Data/Statistics	Fractions, Decimals and Percentages
Convert	Continuous data Line graph	Equivalent decimals Equivalent fractions

New Vocabulary for Year 5

Number and Place Value	Addition and Subtraction	Multiplication and Division	Fractions, Decimals and Percentages
Powers of 10	Efficient written method	Factor pairs Composite number Prime number Prime factor Square number Cubed number Formal written method	Proper fraction Improper fraction Mixed number fraction Percentage Ratio Proportion

Measure	Position and Direction	Properties of Shape
Volume Imperial units Metric units	Reflex angle Dimensions	Regular and irregular polygons

New Vocabulary for Year 6

Number and Place Value	Addition and Subtraction	Data/Statistics	Position and Direction
Numbers to ten million	Order of operations	Mean Pie chart Construct	Four quadrants

Multiplication and Division	Fractions, Decimals and Percentages	Properties of Shape	Algebra
Order of operations Common factors Common multiples	Degree of accuracy Simplify	Vertically opposite Circumference Radius Diameter	Linear number Substitute Variables Symbol Known values